Floral diversity assessment of the buffer zones and vicinity of the Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS), Davao Oriental: basis for inclusion to protected area zone

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ABSTRACT

In 2016, municipal ordinances to expand the protected area of the MHRWS were issued with the aim of protecting and preserving the remaining biodiversity of the buffer zones and to strengthen the core zone. The municipal ordinances however, have limitations and do not guarantee legal promulgation. Hence, this study is on the gathering of complete and concrete floral data so that these expansion sites will become part of the protected area and encompassed in legal promulgations. Botanical fieldworks conducted from Oct to Dec 2017 were carried out in five study sites of the MHRWS expansion sites using 40 20 x 20 m sampling plot with a distance of 20 m between plots and opportunistic transect walk techniques. The study disclosed 228 taxa of plants, of these, 74 species were ferns and lycophytes, 6 species of gymnosperms, 30 species of herbs and vines and 118 species were trees and shrubs. There were three new records of ferns and lycophytes increasing the number of species to 155. There are 13 (5.7%) threatened species, 22 (9.6%) and endemic species. Findings suggest that species in each site are unique and maybe attributed to the vegetation present, elevation variations of the different sampling sites and anthropogenic activities. The proposed expansion sites harbor diverse threatened and plants deserving protection and conservation efforts. Results of this study support the contention that the expansion sites, which are included in the municipal ordinances, be part of the official protected area.

KEYWORDS: biodiversity, Mt. Hamiguitan Range Wildlife Sanctuary expansion sites, Mindanao, Philippines, buffer zone

INTRODUCTION

The Philippines is a home of about 9,500 native vascular plant species, which is about 5% of the World's Flora (Pelser et al. 2011). It is considered as one of the world's eight biodiversity hottest hotspots (Myers et al. 2000).

Mt. Hamiguitan is home to 878 species of plants (Amoroso & Aspiras 2011). Of these, 698 are angiosperms, 25 gymnosperms, 155 ferns and lycophytes which are at risk due to forest degradation and conversion of forested land to agriculture, shifting cultivation, and over-collection.

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Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS) is a protected area by virtue of R.A. 9303 of July 30, 2004 following the objective of NIPAS Act of 1992 or R.A. 7586 (UNESCO 2014). The mountain totals an area of 169.23 km^2 with the highest elevation of 1,637 m a.s.l. (UNESCO 2014) and characterized by a variety of vegetation types including a unique mossy pygmy forest (Amoroso et al. 2009). It is the only mountain peak in Mindanao with a pygmy forest inhabited by unique flora and fauna thus considered as hottest of the "hotspots" (Ong et al. 2002). The mountain is a UNESCO World Heritage Site, ASEAN Heritage Park and also a Mindanao Long Term Ecological Research (LTER) site.

In 2016, municipal ordinances to expand the protected area of the MHRWS were issued with the aim of protecting and preserving the remaining biodiversity of the buffer zones and to fortify the core zone. Thus, this study provides data on floral assemblage in the about 2.99 km^2 expansion sites. The data will be an input to the Protected Area Suitability Assessment (PASA) as required under NIPAS law (R.A.

7586) for appropriate legal promulgations.

MATERIALS AND METHODS

Selection of Study sites and Obtaining of Permits.

The study sites were identified and selected by the DENR Region XI personnel and researchers from Central Mindanao University. The study sites were limited to forest communities within the buffer zone and proposed expansion sites of the MHRWS, which were targeted for inclusion to the protected area. The five study sites, were distributed in the municipalities of San Isidro, Governor Generoso and Mati City (Fig. 1) which were botanically explored after a Wildlife Gratuitous Permit was secured from the Department of Environment and Natural Resources (DENR). The Prior Informed Consent (PIC) from the community was obtained by presenting the overview of the research specifically its objectives. The sites consisted of lowland mixed dipterocarp forest 118-622 m above sea level, slope to rolling plane (10-45°), ultramafic, emergent trees were *Shorea polysperma* (Blanco) Merr., *Ochrosia* spp. and *Gymnostoma rumphianum* (Miq.) L.A.S. Johnson reaching heights up to 32 m high and up to 65 cm dbh.

Establishment of Sampling Plots and Field Sampling.

Botanical fieldworks were carried out in the proposed MHRWS expansion sites from October to December 2017. A total of 40 20 x 20 m sampling plots with a distance of 20 m between each plot were established in the five sampling sites with eight plots per site to compare the alpha and beta diversity. Each plot served as the area for the inventory, diversity studies and assessment. Transect walk was likewise employed in between sampling plots to enrich the data on species richness.

Sampling, Processing, Identification and Data Treatment.

Inventory and listing of the different species of trees with at least 10 cm diameter at breast height (DBH), ferns, lycophytes and other flowering plants inside each 20 x 20m sampling plots were done. The DBH of trees were measured using a diameter tape and the height with the use of laser dendrometer. Representative specimens of vascular plants were collected using the wet method technique, pressed and mounted as herbarium vouchers following standard procedures.

Classification and identification employed the use of books, taxonomic keys, checklist, online database (i.e. Global Plants on JSTOR, Co's Digital Flora of the Philippines) and literature. Plant voucher specimens were deposited at the Central Mindanao University Herbarium (CMUH). Photographs and photomicrographs were taken from suitable, representative plant specimen's *in-situ.*

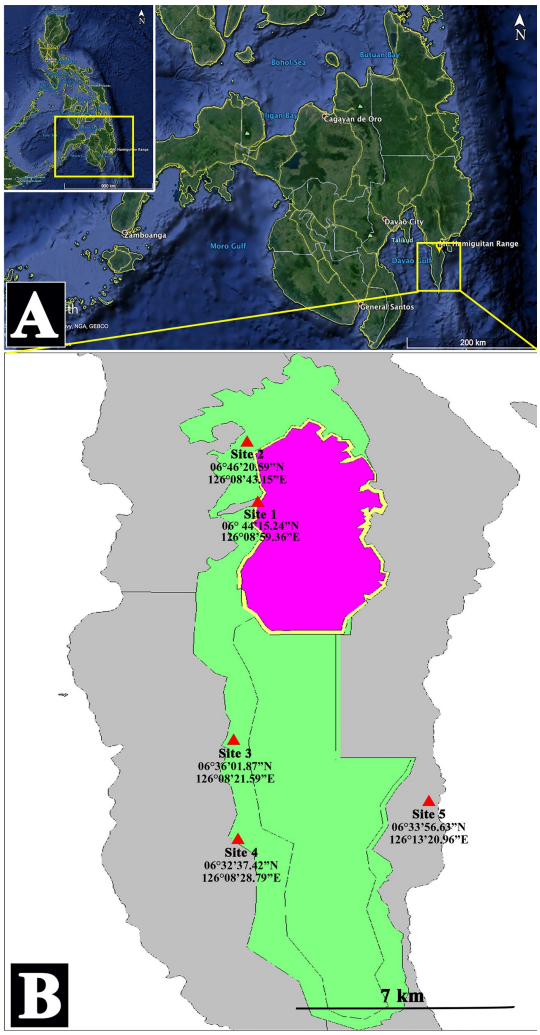

Figure 1. The study sites at Mt. Hamiguitan Range Wildlife Sanctuary expansion sites. A) Mindanao Map, (Philippines, inset), B) Study Sites. Site 1- Sitio Tumalite, Barangay La Union, San Isidro, Davao Oriental (622 masl); Site 2- Sitio Tibanga, Barangay Maputi, San Isidro, Davao Oriental (292 masl); Site 3- Sitio Tagibo, Barangay Oregon, Governor Generoso, Davao Oriental (169 masl); Site 4- Sitio Tagaytay, Barangay Luzon, Governor Generoso, Davao Oriental (175 masl) Site 5- Sitio Ilib, Barangay Cabuaya, Mati City, Davao Oriental (118 masl)

The different parameters for measuring the magnitude of species diversity such as relative density, relative frequency, relative dominance, Shannon index of general diversity (H) and Species Importance Value (SIV) were derived using the following formula: a) for trees H = -S (dbh/Ndbh) log (dbh/ Ndbh), where ndbh is the diameter at breast hight of individual tree species and Ndbh is the total diameter at breast height of all tree species ; b) for pteridophytes H= -S [ni]/N log [ni]/N, where N is the total number of individuals in an area and c) SIV or ni = RD+RF+ Rdom, where RD = Relative Density, RF = Relative Frequency and Rdom = Relative Dominance.

RESULTS AND DISCUSSION

Species Composition

Field inventory in the MHRWS expansion sites revealed 228 taxa of plants, which are distributed to 96 families and 171 genera (see Table 1). Of these, 74 species were ferns and lycophytes belonging to 24 families and 49 genera (see Table 4), 6 species of gymnosperms belonging to 3 families and 5 genera (see Table 2), 30 species were herbs and vines (flowering plants) placed in 17 families and 27 genera (see Table 3) and 118 species were trees and shrubs (seed plants) distributed among 52 families and 90 genera (see Table 2).

The floral species composition within the expansion sites is relatively high constituting about 26% of the total number of species found in entire MHRWS as reported by Amoroso and Aspiras (2011). The documented ferns and lycophytes comprise 49% of the total number in the entire range as reported by Amoroso et al. (2016). The new records of ferns and lycophytes in the Mt. Hamiguitan Range include *Phlegmariurus phlegmaria* (Lycopodiaceae), *Pityrogramma calomelanos* (Pteridaceae) and *Drynaria sparsisora* (Desv.) T. Moore (Polypodiaceae) increasing the species to 155 based on the most recent checklist (Amoroso et al. 2016).

The estimate of species richness of ferns and lycophytes of the entire range (155 spp.) closely resembles to the Karst Forest in Bohol Island with 169 spp. (Barcelona et al. 2006), Mt. Bali-it in Balbalasang-Balbalan National Park, and Northern Luzon with 167 ssp. (Barcelona 2003), Marilog Forest reserve in the area of Davao City with 165 spp. (Amoroso et al. 1996). The site harbors more species than Mt. Pinamantawan in Quezon of Bukidnon Province with 121 spp. (Sumagaysay 2012), Mt. Iraya and its vicinity in Batan Island, Batanes Province with 89 spp. (Barcelona 2003), Mt. Pangasugan on Leyte Island with 94 spp. (Belonias & Banoc 1994), Pasonanca Natural Park in the region of Zamboanga City with 72 spp. (Andas 2015), and Mt. Makulot in Batangas Province, Southern Luzon with 40 spp. (Catapang et al. 2012). However, it is relatively lower than that of Mt. Kitanglad, Bukidnon Province with 439 spp. (Amoroso et al. 2011), Panay Island with 228 spp. (Barcelona 2004), Mt. Burnay and its vicinity in Northern Luzon with 199 spp. (Iwatsuki & Price 1977), and Mt. Malindang, Misamis Occidental Province with 280 spp. (Amoroso et al. 2006).

The families of plants with the highest number of species are Polypodiaceae (11 species), Pteridaceae (9), Selaginellaceae (5), Aspleniaceae, Davalliaceae, Lindsaeaceae, Tectariaceae and Thelypteridaceae with 4 species each, Rubiaceae (16 species), Orchidaceae (12 species), Myrtaceae (15), Moraceae (6), Apocynaceae (7), Fabaceae (5), and the rest of the families have at most 3 species. The common families of ferns are also widely distributed in Mindanao i.e. Mt. Apo (North Cotabato), Mt. Kitanglad (Bukidnon), Mt. Malindang (Misamis Occidental), Mt. Hamiguitan (Davao Oriental) and Mt. Musuan (Bukidnon) (Amoroso et al. 2009, 2015). The fern families with highest number of species in the expansion sites also contain the highest number of species in the Philippines (Salgado 1990).

Diversity Index Values

The average diversity index value of trees (H'=1.3) in the proposed expansion sites is comparatively lower compared to the 0.01 km^2 permanent plot in Mt. Musuan, Bukidnon (H' =1.93), Mt. Malindang, Misamis Occidental (H'= 1.68), Mt. Apo (H'= 1.57), Mt. Hamiguitan (H'=1.57) and Mt. Kitanglad (H'=1.43) (see Table 5).

The diversity index value of pteridophytes in the proposed expansion sites was relatively lower with average diversity value of H'=0.6, compared to the permanent plot of Mt. Malindang, Misamis Occidental (H'= 1.41), Mt. Kitanglad, Bukidnon (H'= 1.37), Mt. Apo (H'= 1.26), Mt. Musuan, Bukidnon (H'=1.01) and Mt. Hamiguitan (H'= 0.91) (Amoroso et al. 2015) (see Table 5).

Species Importance Value (SIV)

The species with high Species Importance Value (SIV) for ferns and lycophytes in all the study sites include: *Taenitis blechnoides, Selaginella jagorii, Sphaeropteris polypoda, Schizaea dichotoma, Pteridium aquilinum, Tectaria laxa, Lindsaea gueriniana, Adiantum hosei, Pyrrosia lanceolata,*

Table 1. Species composition of flora in MHRWS expansion sites.

Plant Group	No. of Families	No. of Genera	No. of Species
Ferns and Lycophytes	24	49	74
Gymnosperms	3	5	6
Herbs and Vines (flowering plants)	17	27	30
Trees and Shrubs (seed plants)	52	90	118
Total	96	171	228

Table 2. Checklist of trees and shrubs in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
	Angiosperms			
	Acanthaceae	*Justicia* sp.	-	-
	Actinidiaceae	*Saurauia* sp.	-	-
		Saurauia avellana Elmer	-	-
VBA 7221	Anacardiaceae	*Buchanania arborescens* (Blume)		
		Blume	-	-
VBA 7192		*Semecarpus* sp.	-	-
	Annonaceae	*Huberantha rumphii* (Blume ex		
		Hensch.) Chaowasku	-	-
	Apocynaceae	*Alstonia scholaris* (L.) R.Br.	-	-
		Melodinus philippinensis A. Dc.	-	PE
VBA 7184		*Ochrosia apoensis* Elmer	-	-
VBA 7390		*Ochrosia glomerata* (Blume) F. Muell.	-	-
VBA 7202		*Tabernaemontana pandacaqui* Lam.	-	-
	Araliaceae	*Osmoxylon luzoniense* (Merr.)		
		Philipson	-	-
		Polyscias aherniana (Merr.) Lowry &		
		G.M.Plunkett	-	-
	Arecaceae	*Pinanga* sp.	-	-
	Bignoniaceae	*Radermachera* sp.	-	-
VBA 7400	Burseraceae	*Canarium asperum* Benth.	-	-
VBA 7220				
	Calophyllaceae	*Calophyllum mindanaense* Elmer	-	-
	Cannabaceae	*Celtis* sp.	-	-
VBA 7215	Casuarinaceae	*Gymnostoma rumphianum* (Miq.)		
		L.A.S. Johnson	-	-
	Clusiaceae	*Garcinia* sp.	-	-
		Mammea ultramafica P. F. Stevens	-	-
	Cunoniaceae	*Weinmannia* sp.	-	-
VBA 7213	Dilleniaceae	*Dillenia philippinensis* Rolfe	-	PE
	Dipentodontaceae	*Perrottetia* sp.	-	-
VBA 7177	Dipterocarpaceae	*Shorea astylosa* Foxw.	CR	PE
		Shorea polysperma Merr.	VU	PE

Table 2 cont. Checklist of trees and shrubs in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
	Ebenaceae	*Diospyros* sp.	-	-
VBA 7380	Elaeocarpaceae	*Elaeocarpus* sp.	-	-
VBA 7371	Ericaceae	*Vaccinium agusanense* Elmer	-	ME
	Euphorbiaceae	*Macaranga gigantifolia* Merr.	-	-
		Macaranga sp.	-	-
		Sauropus villosus (Blanco) Merr.	-	-
VBA 7385		*Sauropus* sp.	-	-
VBA 7274				
	Fabaceae	*Archidendron ellipticum* (Blanco)	-	
		I.C. Nielsen		
VBA 7397		*Callerya scandens* (Elmer) Schot	-	-
		Cynometra sp.	-	-
		Ormosia sp.	-	-
	Fagaceae	*Lithocarpus sulitii* Soepadmo	-	PE
		Lithocarpus woodii (Hance) A.Camus	-	-
		Lithocarpus sp.	-	-
		Castanopsis evansii Elmer	-	PE
	Gentianaceae	*Fagraea philippinensis* K.M.Wong		
		& Sugau	-	-
	Hypericaceae	*Cratoxylum* sp.	-	-
VBA 7405	Lamiaceae	*Callicarpa flavida* Elmer	-	-
		Teijsmanniodendron ahernianum		
		(Merr.) Bakh.	-	-
	Lauraceae	*Actinodaphne akoensis* var *hayatae*		
		(Kaneh.) J.C. Liao	-	-
VBA 7126		*Cinnamomum mercadoi* Vidal	OTS	-
		Cinnamomum sp.	-	-
		Litsea sp.	-	-
	Lecythidaceae	*Barringtonia racemosa* (L.) Spreng	-	-
		Barringtonia sp.	-	-
	Melastomataceae	*Astronia* sp.	-	-
		Medinilla multiflora Merr.	-	-
VBA 7208		*Melastoma malabathricum* L.	-	-

Table 2 cont. Checklist of trees and shrubs in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
	Meliaceae	*Aglaia luzoniensis* Merr. & Rolfe	-	-
	Moraceae	*Artocarpus multifidus* F.M. Jarrett	-	-
		Streblus elongatus (Miq.) Corner	-	-
VBA 7257		*Ficus botryocarpa* Miq.	-	-
		Ficus pseudopalma Blanco	-	-
		Ficus elmeri var. *subintegra* Merr.	-	-
		Ficus sp.	-	-
VBA 7267	Myristicaceae	*Horsfieldia* sp.	-	-
VBA 7403	Myrsinaceae	*Myrsine glandulosa* (Elmer) Pipoly	-	-
	Myrtaceae	*Leptospermum javanicum* Blume	-	-
		Rhodomyrtus surigaoensis Elmer	-	-
VBA 7204		*Syzygium antisepticum* (Blume) Merr. & L.M.Perry	-	ME
		Syzygium incarnatum (Elmer) Merr. & L.M. Perry	-	-
		Syzygium rubrovenium (C. B. Rob.) Merr.	-	-
VBA 7391		*Syzygium* sp. 1	-	-
VBA 7370		*Syzygium* sp. 2	-	-
VBA 7373		*Syzygium* sp. 3	-	-
VBA 7386		*Syzygium* sp. 4	-	-
VBA 7219		*Syzygium* sp. 5	-	-
		Syzygium sp. 6	-	-
		Syzygium sp. 7	-	-
		Syzygium sp. 8	-	-
		Tristaniopsis decorticata (Merr.) Peter G.Wilson & J.T. Waterh.	VU	-
	Pandanaceae	*Benstonea copelandii* (Merr.) Callm. & Buerki	-	-
		Pandanus clementis Merr.	-	-
		Sararanga sinuosa Hemsl.	-	-
	Pentaphylacaceae	*Eurya* sp.	-	-
		Ternstroemia philippinensis Merr.	-	-

Table 2 cont. Checklist of trees and shrubs in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
VBA 7216	Phyllanthaceae	*Antidesma* sp.	-	-
VBA 7266		*Breynia cernua* Müll.Arg.	-	-
	Pittosporaceae	*Pittosporum euphlebium* Merr.	-	-
	Polygalaceae	*Polygala venenosa* Juss. ex Poir.	-	-
VBA 7412	Primulaceae	*Ardisia* sp.	-	-
VBA 7203	Proteaceae	*Helicia paucinervia* Merr.	-	-
VBA 7347	Rhamnaceae	*Alphitonia excelsa* (Fenzl) Benth. var. *excelsa* (Fenzl) Benth.	-	-
	Rosaceae	*Prunus* sp.	-	-
	Rubiaceae	*Greeniopsis multiflora* (Elmer) Merr.	-	-
VBA 7375		*Greeniopsis* sp.	-	-
		Ixora philippinensis Merr.	-	PE
		Ixora sp.	-	-
VBA 7348		*Morinda coriacea* Merr.	-	-
		Morinda citrifolia L	-	-
		Mussaenda philippica A.Rich. var. *philippica*	-	-
		Nauclea wenzelii Merr.	-	-
		Nauclea sp.	-	-
VBA 7205		*Psychotria mariguidonensis* Sohmer & A.P.Davis	-	-
VBA 7406		*Psychotria* sp.	-	-
VBA 7380		*Timonius trichophorus* Merr.	-	-
VBA 7402		*Timonius* sp.	-	-
		Wendlandia nervosa Merr.	-	-
	Rutaceae	*Adenandra* sp.	-	-
VBA 7381		*Lunasia amara* Blanco	-	-
		Melicope sp.	-	-
		Zanthoxylum diabolicum Elmer	-	-
VBA 7376		*Acronychia* sp.	-	-
VBA 7180	Sapindaceae	*Ganophyllum falcatum* Blume	-	-
VBA 7199		*Guioa discolor* Radlk.	-	-
VBA 7384	Sapotaceae	*Palaquium* sp.	-	-

Table 2 cont. Checklist of trees and shrubs in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
	Staphyleaceae	*Turpinia ovalifolia* Elmer	-	-
VBA 7392	Stemonuraceae	*Gomphandra* cf. *apoensis*	-	-
	Sterculiaceae	*Sterculia* sp.	-	-
VBA 7206		*Commersonia bartramia* (L.) Merr.	-	-
VBA 7200	Urticaceae	*Leucosyke elmeri* Unruh	-	-
	Vitaceae	*Leea guineensis* G. Don	-	-
	Gymnosperms			
	Araucariaceae	*Agathis philippinensis* Warb.	-	-
	Gnetaceae	*Gnetum gnemon* L.	-	-
		Gnetum latifolium Blume	-	-
	Podocarpaceae	*Falcatifolium gruezoi* de Laub.	-	-
		Nageia wallichiana Kuntze	-	-
VBA 7399		*Podocarpus philippinensis* Foxw.	-	-

No available reproductive organs for taxa identified only to the genus level
CR- Critically Endangered, VU- Vulnerable, OTS- Other Threatened Species, ME- Mindanao Endemic, PE- Philippine Endemic

Table 3. Checklist of other flowering plants (herbs & vines) in the MHRWS expansion sites

Family	Species	Conservation Status	Ecological Status
Apocynaceae	*Dischidia major* (Vahl) Merr.	-	-
	Hoya sp.	-	-
Araceae	*Pothos* sp. 1	-	-
	Pothos sp. 2	-	-
Arecaceae	*Calamus* sp.	-	-
Dilleniaceae	*Tetracera scandens* (L.) Merr.	-	-
Fabaceae	*Bauhinia pauciflora* Merr.	-	-
Flagellariaceae	*Flagellaria indica* Linn.	-	-
Goodeniaceae	*Scaevola pedunculata* Merr.	-	-
Loranthaceae	*Amyema celebica* Danser	-	-
Melastomataceae	*Sarcopyramis* sp.	-	-
Nepenthaceae	*Nepenthes mindanaoensis* Kurata	VU	PE
	Nepenthes alfredoi Amoroso & Lagunday	CR	PE

Table 3 cont. Checklist of other flowering plants (herbs & vines) in the MHRWS expansion sites

Family	Species	Conservation Status	Ecological Status
Orchidaceae	*Bulbophyllum brevibrachiatum* J.J.Sm.	-	PE
	Cadetia microphyton (L.O. Williams) Christenson	-	PE
	Crepidium sp.	-	-
	Liparis parviflora (Blume) Lindl.	-	-
	Paphiopedilum ciliolare (Rchb.f.) Stein	CR	-
	Podochilus intricatus Ames	-	-
	Pteroceras sp.	-	-
	Thecostele alata C.S.P.Parish & Rchb.f.	-	-
	Trichoglottis geminata J.J.Sm.	-	PE
	Trichoglottis latisepala Ames	-	ME
Pandanaceae	*Freycinetia cumingiana* Gaudich.	-	PE
Pentaphragmataceae	*Pentaphragma grandiflorum* Kurz	-	-
Piperaceae	*Piper lessertianum* C. DC.	-	-
Rubiaceae	*Hydnophytum formicarum* Jack	-	-
	Myrmecodia tuberosa Jack	-	-
Smilacaceae	*Smilax bracteata* var. *heterophylla* Merr. & Quisumb.	-	-
Zingiberaceae	*Alpinia musifolia* Ridl.	-	-

No available reproductive organs for taxa identified only to the genus level
CR- Critically Endangered, VU- Vulnerable, OTS- Other Threatened Species, ME- Mindanao Endemic, PE- Philippine Endemic

Table 4. Checklist of ferns and lycophytes in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
VBA 7398	Lycopodiaceae	*Phlegmariurus phlegmaria* (L.) Holub	EN	-
VBA 7324	Selaginellaceae	*Selaginella alligans* Hieron.	-	-
VBA 7269		*S. cupressina* (Willd.) Spring	-	-
VBA 7155		*S. involvens* (Sw.) Spring	-	-
VBA 7102		*S. jagorii* Warb.	-	PE
VBA 7036		*Selaginella* sp.1	-	-
	Aspleniaceae	*Asplenium excisum* C. Presl	-	-
VBA 7161		*A. nigrescens* Hook. f.	-	-
VBA 7251		*A. polyodon* G. Forst.	-	-
		A. tenerum G. Forst.	-	-
	Athyriaceae	*Athyrium puncticaule* (Blume) T. Moore	-	-
		Diplazium sp.	-	-
	Blechnaceae	*Blechnum egregium* Copel.	-	-
	Cyatheaceae	*Sphaeropteris elmeri* R.M.Tryon	VU	PE
		S. glauca (Blume) R.M. Tryon	EN	-
		S. polypoda R.M.Tryon	-	-
VBA 7243	Davalliaceae	*Davallia heterophylla* Sm.	-	-
VBA 7025		*D. solida* (G. Forster) Swartz	-	-
		Davallodes hirsutum (J.Sm.) Copel.	-	-
		Humata repens (L. f.) J. Small ex Diels	-	-
VBA 7156	Dennstaedtiaceae	*Orthiopteris campylura* (Kunze) Copel.	-	-
		Pteridium aquilinum (L.) Kuhn	-	-
VBA 7286	Dicksoniaceae	*Calochlaena javanica* (Bl.) G.B.Nair	-	-
	Dryopteridaceae	*Ctenitis* sp.	-	-
		Dryopteris sp.	-	-
VBA 7101		*Lomagramma pteroides* J. Sm.	-	-

Table 4 cont. Checklist of ferns and lycophytes in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
	Gleicheniaceae	*Dicranopteris curranii* Copel.	-	-
		Dicranopteris linearis (Burm.f.) Underw.	-	-
	Hymenophyllaceae	*Diplopterygium longissimum* (Blume) Nakai	-	-
VBA 7104		*Cephalomanes atrovirens* C. Presl	-	-
VBA 7182	Lindsaeaceae	*Lindsaea gueriniana* (Gaudich.) Desv.	-	-
VBA 7108		*L. hamiguitanensis* Karger & V.B.Amoroso	OTS	ME
		Odontosoria retusa (Cav.) J. Sm.	-	-
VBA 7024		*Tapeinidium luzonicum* (Hook.) K.U. Kramer	-	-
VBA 7275	Lomariopsidaceae	*Nephrolepis biserrata* (Sw.) Schot	-	-
		N. cordifolia (L.) Presl	-	-
		N. hirsutula (G. Forst.) C. Presl	-	-
	Lygodiaceae	*Lygodium circinnatum* (Burm. fil.) Sw.	-	-
VBA 7228		*L. flexuosum* (L.) Sw.	-	-
	Marattiaceae	*Angiopteris evecta* (G.Forst.) Hoffm.	-	-
	Ophioglossaceae	*Ophioderma reticulatum* L.	-	-
	Osmundaceae	*Osmunda banksiifolia* (Presl) Kuhn	-	-
	Polypodiaceae	*Drynaria descensa* Copel.	-	-
		D. quercifolia (L.) J.Sm	-	-
		D. sparsisora (Desv.) T. Moore	-	-
VBA 7142		*Lecanopteris sinuosa* (Wall. ex Hook.) Copel.	VU	-

Table 4 cont. Checklist of ferns and lycophytes in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
VBA 7150		*Lepisorus longifolius* (Blume) Holttum	-	-
VBA 7250		*Microsorum scolopendria* (Burm f.) Copel.	-	-
VBA 7299		*Platycerium coronarium* (J. Koenig ex O. F. Müll.) Desv.	CR	-
VBA 7201		*Pyrrosia adnascens* (Swartz) Ching.	-	-
VBA 7374		*P. lanceolata* (L.) Farw.	-	-
VBA 7332		*P. samarensis* (C. Presl) Ching	-	PE
		Selliguea taeniata (Sw.) Parris	-	-
VBA 7388	Psilotaceae	*Psilotum nudum* (L.) Griseb.	VU	-
VBA 7322	Pteridaceae	*Adiantum hosei* Baker	-	ME
		Antrophyum sp.	-	-
VBA 7302		*Haplopteris ensiformis* (Sw.) E.H. Crane	-	-
		Pityrogramma calomelanos (L.) Link	-	-
VBA 7331		*Pteris oppositipinnata* Fée	-	PE
VBA 7338				
VBA 7252				
VBA 7288		*Pteris* sp.	-	-
VBA 7367		*Pteris vittata* L.	-	-
		Syngramma alismifolia (C. Presl) J. Sm.	-	-
VBA 7181		*Taenitis blechnoides* (Willd.) Sw.	-	-
	Schizaeaceae	*Schizaea dichotoma* (L.) Sm.	-	-
		S. digitata (L.) Sw.	-	-
VBA 7106		*S. inopinata* Selling	-	-
	Tectariaceae	*Pleocnemia irregularis* (C. Presl) Holttum	-	-

Table 4 cont. Checklist of ferns and lycophytes in the MHRWS expansion sites

Collection No.	Family	Species	Conservation Status	Ecological Status
VBA 7264		*Tectaria crenata* Cav.	-	-
VBA 7162		*T. polymorpha* (Wall. ex Hook.) Copel.	-	-
VBA 7327		*T. laxa* (Copel.) M.G.Price	-	PE
VBA 7287	Thelypteridaceae	*Christella dentata* (Forsk.) Brownsey & Jermy	-	-
VBA 7355		*Macrothelypteris polypodioides* (Hook.) Holttum	-	-
		Pronephrium nitidum Holttum	-	-
		Sphaerostephanos unitus (L.) Holttum	-	-

Table 5. Species richness and diversity values of trees and pteridophytes in MHRWS expansion sites

Site	Coordinates	Elevation (masl)	Trees		Ferns & Lycophytes	
			Species Richness	Diversity Index (H)	Species Richness	Diversity Index (H)
Site 1	06° 44'15.24"N 126°08'59.36"E	622	67	1.35	50	0.93
Site 2	06°46'20.59"N 126°08'43.15"E	292	65	1.24	11	0.55
Site 3	06°36'01.87"N 126°08'21.59"E	169	70	1.38	33	0.71
Site 4	06°32'37.42"N 126°08'28.79"E	175	50	1.10	19	0.07
Site 5	06°33'56.63"N 126°13'20.96"E	118	45	1.21	14	0.73
Average			59.4	1.3	25.4	0.6

Table 6. Species with high Species Importance Value (SIV) in MHRWS expansion sites

Species	SIV
Site 1	
Taenitis blechnoides (Willd.) Sw.	77.32
Selaginella jagorii Warb.	56.75
Sphaeropteris polypoda R.M.Tryon	55.69
Macaranga sp.	24.21
Teijsmanniodendron ahernianum (Merr.) Bakh.	19.31
Lithocarpus woodii (Hance) A. Camus	18.56
Site 2	
Taenitis blechnoides (Willd.) Sw.	160.62
Schizaea dichotoma (L.) Sm.	47.60
Ochrosia glomerata Valeton	30.36
Ochrosia apoensis Elmer	23.66
Artocarpus multifidus F.M. Jarrett	22.33
Site 3	
Taenitis blechnoides (Willd.) Sw.	100.79
Schizaea dichotoma (L.) Sm.	89.51
Tectaria laxa (Copel.) M.G. Price	47.93
Sloetia elongata Koord.	26.33
Buchanania arborescens (Blume) Blume	18.66
Greeniopsis multiflora (Elmer) Merr.	17.98
Site 4	
Lindsaea gueriniana (Gaudich.) Desv.	120.18
Taenitis blechnoides (Willd.) Sw.	95.15
Ochrosia glomerata Valeton	24.00
Shorea astylosa Foxw.	22.40
Gymnostoma rumphianum (Miq.) L.A.S. Johnson	22.09
Teijsmanniodendron ahernianum (Merr.) Bakh.	22.07
Palaquium sp.	22.05
Site 5	
Pyrrosia lanceolata (L.) Farw.	88.63
Nephrolepis hirsutula (G. Forst.) C. Presl	57.76
Lygodium circinnatum (Burm. fil.) Sw.	57.76
Dicranopteris linearis (Burm.f.) Underw.	54.27
Syzygium sp.	37.56
Shorea astylosa Foxw.	35.37
Ochrosia glomerata Valeton	24.96

Nephrolepis hirsutula and *Lygodium circinnatum.* It was found out that *T. blechnoides* is widely distributed in almost all the sites except in site 5. This species ranks 1st or 2nd most dominant species of ferns within the Mt. Hamiguitan expansion site (see Table 6).

For the trees, *Macaranga* sp., *Teijsmanniodendron ahernianum, Lithocarpus woodii, Ochrosia glomerata, Ochrosia apoensis, Artocarpus multifidus, Streblus elongatus, Buchanania arborescens, Greeniopsis multiflora, S. astylosa, G. rumphianum* and *Syzygium* spp., obtained a high species importance value. The removal or loss of the species would affect the forest community. The inclusion of the Philippine endemic species, *Greeniopsis multiflora* and endangered species, *Shorea astylosa* in the list imply high priority for protection and conservation. The removal of these species with high SIV would affect the forest vegetation (Table 6).

Notes on Conservation and Ecological Status

A total of 13 (5.7%) threatened species of flora were documented (see Fig. 2) based on DAO (2017) and IUCN (2018). These include six flowering plants (see Tables 2 and 3) and seven species of ferns and lycophytes (see Table 4). Four species are listed as critically endangered (CR), *Nepenthes alfredoi* V.B. Amoroso and Lagunday*, Paphiopedilum ciliolare* Rchb. F.) Stein.*, Platycerium coronarium* (J. Koenig ex O.F. Mull) Desv.*, Shorea astylosa* Foxw., *Phlegmariurus phlegmaria* (L.) Holub and*, Sphaeropteris glauca* (Blume) R.M. Tryon were listed as endangered (EN) species while five species vulnerable (VU) viz., *Sphaeropteris elmeri* R.M. Tryon*, Lecanopteris sinuosa* (Wall. Ex Hook.) Copel.*, Psilotum nudum* (L.) Griseb.*, Shorea polysperma* Merr.*, Tristaniopsis decorticata* (Merr.) Peter G. Wison & J.T. Waterh. Two species considered as Other Threatened Species (OTS), i.e. *Lindsaea hamiguitanensis* Karger & V.B. Amoroso and *Cinnamomum mercadoi* S. Vidal.

This study, reports a total of 22 (9.6%) endemic species of plants, with 16 Philippine endemic and six Mindanao endemics recorded in the expansion sites. Of these 15 species are flowering plants (see Tables 2 and 3), and 7 species are ferns and lycophytes (see Table 4). This finding implies that the flowering plants have high endemicity in the expansion sites and thus harbor species that are unique to the country.

New Records of Fern and Lycophyte Species in Mt. Hamiguitan Range

The new records of ferns and lycophytes in the Mt. Hamiguitan Range include *Phlegmariurus phlegmaria* (Lycopodiaceae), *Pityrogramma calomelanos*, (Pteridaceae) and *Drynaria sparsisora* (Desv.) T. Moore (Polypodiaceae).

Conclusions and Recommendation

The botanical study in MHRWS expansion sites revealed 228 taxa of plants. Of these, 74 species were ferns and lycophytes, six species of gymnosperms, 30 species of herbs and vines and 118 species of trees and shrubs which is about 26% of the total number of plants species recorded in the entire range. Three new records of fern and lycophyte species for the entire range were documented in addition to the recent checklist increasing it to 155. The families of trees, shrubs and other flowering plants with the highest number of species are Rubiaceae (16 species), Orchidaceae (10 species), Myrtaceae (14), Apocynaceae (7), Moraceae (6), Fabaceae (5), and the rest of the families have at most 3 species. The species diversity value for trees and pteridophytes were 1.3 and 0.6 respectively. There were 13 (5.7%) threatened species, 22 (9.6%) endemic species. Findings suggest that species in each site are unique and maybe attributed to the vegetation present, elevation variations of the different sampling sites and anthropogenic activities. The proposed expansion sites harbor diverse threatened and endemic plants deserving protection and conservation efforts. Threats to biodiversity in the sites include shifting cultivation, illegal logging and mining. Results of this study support the contention that the expansion sites, which are included in the municipal ordinances, be part of the official protected area and appeals for immediate conservation strategies by the stakeholders.

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